

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : FWD - REACTION CONTROL FMEA NO 03-2F -101060 -2 REV:04/09/88

ASSEMBLY : PRESSURIZATION SUBSYSTEM
P/N RI : MC284-0421-0011,-0012
P/N VENDOR: 5760009-111,-112
QUANTITY : 2
: 1 PER PROPELLANT

VEHICLE
EFFECTIVITY:
PHASE(S): PL LO X OO DO LS
CRIT. FUNC: 13
CRIT. HDW: 2
102 103 104
X X X

PREPARED BY: J LAZARUS
DES R P DIEHL
REL W J SMITH
QE
REDUNDANCY SCREEN: A-PASS B-N/A C-PASS
APPROVED BY: [Signature] APPROVED BY (NASA):
DES [Signature] SSM [Signature]
REL [Signature] REL [Signature]
QE [Signature] QE [Signature]

ITEM:
VALVE RELIEF, PRESSURE, BURST DISC & POPPET (RV101,RV102).

FUNCTION:
PROVIDES PRESSURE RELIEF IN EVENT REGULATOR FAILS OPEN OR PROPELLANT PRESSURE RISES DUE TO THERMAL INCREASE. THE S.S. BURST DISC RELIEF PRESSURE IS 324 TO 340 PSI. THE MAIN POPPET MINIMUM CRACKING PRESSURE IS 315 PSI AND THE MINIMUM RESEAT PRESSURE IS 310 PSI. AMBIENT PRESSURE SENSING (EXTERNAL) IS PROVIDED SINCE THE VALVE OUTLET IS SUBJECTED TO BACK-PRESSURE. STAINLESS STEEL BURST DISK ASSEMBLY CONTROLLED BY INLET PRESSURE ACTING ON BELLEVILLE SPRING PROTECTS RELIEF VALVE FROM PROPELLANT EXPOSURE.

FAILURE MODE:
INTERNAL LEAK FAILS OPEN, MAIN POPPET LEAKS OR MAIN POPPET DOES NOT RESEAT AS REQ'D AFTER BURST DISK RUPTURE.

CAUSE(S):
INCORRECT PRESSURE SETTING, FATIGUE, SHOCK, EXCESS PRESSURE CYCLING, VIBRATION, MAT'L DEFECT, CORROSION, CONTAMINATION, POPPET BINDS IN GUIDE

EFFECT(S) ON:
(A) SUBSYSTEM (B) INTERFACES (C) MISSION (D) CREW/VEHICLE
(A) NO EFFECT UNLESS MULTIPLE FAILURES OCCUR.
(B) LOSS OF REDUNDANCY.
(C) NO EFFECT
(D) NO EFFECT
(E) FUNCTIONAL CRITICALITY EFFECT - POSSIBLE LOSS OF CREW/VEHICLE IF ULLAGE PRESSURE IS DEPLETED. INABILITY TO PERFORM MATED COAST/ET SEP DUE TO LOSS OF PROPELLANT TANK PRESSURIZATION.

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DISPOSITION & RATIONALE:

(A) DESIGN (B) TEST (C) INSPECTION (D) FAILURE HISTORY (E) OPERATIONAL USE

(A) DESIGN

THE BURST DISK AND RELIEF VALVE POPPET ARE REDUNDANT FOR EXTERNAL LEAKAGE. A 25 MICRON FILTER DOWNSTREAM OF THE BURST DISK REDUCES THE POTENTIAL FOR CONTAMINATION CAUSED LEAKAGE FAILURES.

THE MAIN POPPET STEM IS A SEPARATE PIECE FROM THE MAIN SENSING SPRING ACTUATION MECHANISM. THIS PROVIDES CLOSE TOLERANCE CONTROL OF OPENING SPRING FORCE. THE VALVE MATERIALS ARE ALL COMPATIBLE WITH PROPELLANT.

(B) TEST

THE QUALIFICATION TEST PROGRAM INCLUDED RANDOM VIBRATION, SHOCK (PER MIL-STD-810 20g PEAK), THERMAL CYCLE (+20 TO +150 DEG F), ENDURANCE (80 CYCLES-RELIEF VALVE AND 36,500 CYCLES FOR THE BURST DISK), AND PROPELLANT COMPATIBILITY. THE UNIT ALSO WAS QUALIFIED AS PART OF THE POD ASSEMBLY DURING THE VIBRO-ACOUSTIC TESTING AT JSC (131 EQUIVALENT MISSIONS).

THE HOT FIRE TEST PROGRAM AT WSTF SUBJECTED THE UNIT TO 24 EQUIVALENT MISSION DUTY CYCLES AND APPROX 7 YEARS OF PROPELLANT EXPOSURE.

ACCEPTANCE TESTING INCLUDES PROOF PRESSURE, EXTERNAL LEAKAGE, INTERNAL LEAKAGE, CRACKING AND RESEAT PRESSURE, FLOW CAPACITY, CLEANLINESS AND DRYING, PROOF AND LEAK TESTING OF WELDED JOINTS OF THE BELLAWS, AND CHECKING OF PROPER SET POINT OF THE BURST DISK ACTUATOR.

OMRSD PERFORMS THE FOLLOWING: A RELIEF VALVE LEAK/FUNCTIONAL TEST EVERY FIFTH FLIGHT AND ON A CONTINGENCY BASIS.

(C) INSPECTION

RECEIVING INSPECTION

INSPECTION VERIFIES MATERIAL AND PHYSICAL PROPERTIES.

CONTAMINATION CONTROL

CLEANLINESS OF THE RELIEF VALVE INTERNAL FLOW CAVITY TO LEVEL 100 FOR THE MC284-0421-0011 AND LEVEL 100A FOR THE MC284-0421-0012 AND CORROSION PROTECTION ARE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

DIMENSIONAL AND VISUAL INSPECTION IS VERIFIED BY INSPECTION. MANUFACTURING PROCESSES, INSTALLATION, AND ASSEMBLY OPERATIONS ARE VERIFIED BY INSPECTION. TEFLON GUIDE RING INSTALLATION IS VERIFIED BY INSPECTION. CRITICAL DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY INSPECTION. SEAT IS VERIFIED BY INSPECTION TO BE FREE OF SURFACE DEFECTS AND CRACKS PRIOR TO ASSEMBLY.

NONDESTRUCTIVE EVALUATION

RADIOGRAPHIC INSPECTION OF WELD NUMBER W8 (PER EP55760009) PER MIL-STD-453 IS VERIFIED BY INSPECTION. PENETRANT INSPECTION PER MIL-I-6866 TYPE 1, METHOD A OR C, OF WELD NUMBER W3, W5, W8, W9, AND W11 IS VERIFIED BY INSPECTION.

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CRITICAL PROCESSES

WELDING PER EPS5760009 IS VERIFIED BY INSPECTION. VISUAL OR 10X MAGNIFICATION INSPECTION OF ALL WELDS PER EPS5760009 IS VERIFIED BY INSPECTION. PROOF PRESSURE TEST AND LEAK TEST OF CERTAIN WELDS IS VERIFIED BY INSPECTION.

TESTING

ATP IS WITNESSED AND VERIFIED BY INSPECTION.

HANDLING/PACKAGING

PACKAGING OF THE FINAL ASSEMBLY FOR SHIPMENT PER 1EP5760009 IS VERIFIED BY INSPECTION. HANDLING AND STORAGE REQUIREMENTS ARE VERIFIED BY INSPECTION. RETURNED AND ACCEPTED GOODS ARE KEPT IN BONDED AREAS AND VERIFIED BY INSPECTION.

(D) FAILURE HISTORY

NO FLIGHT FAILURE HISTORY. CARS AC0826 AND AB5024 RECORD RESEAT PRESSURE PROBLEMS WERE ASSOCIATED WITH AN OLDER DESIGN CONFIGURATION.

CAR AB3925 AND AB4118 RECORDS LOW RESEAT PRESSURE DUE TO LACK OF LUBRICANT ON DIAPHRAGM ASSEMBLY AND GUIDE. UNITS WERE RETURNED FOR DISASSEMBLY, REBUILD AND LUBRICANT PER DRAWING REQUIREMENTS. THE SUPPLIER AMR 5762.52 WAS REVISED ACCORDINGLY. THE UNITS WERE IDENTIFIED WITH NEW CARD NUMBERS.

CARS AB8367 AND AB8518 IDENTIFIED LOW RESEAT PRESSURE DURING DELTA QUAL TEST DUE TO INTERNALLY GENERATED CONTAMINATION THAT WAS INDUCED FROM THE TEST SET UP. THE UNITS HAD BEEN USED IN THE PRIOR QUAL TEST AND THE MAIN POPPET STEM AND GUIDE HAD NOT BEEN REPLACED. THE TEST STAND WAS CLEANED ADDITIONAL FILTERS INSTALLED AND THE UNIT REBUILT PRIOR TO TEST RESTART.

CAR AC3009 RECORDS LOW RESEAT PRESSURE DURING ATP DUE TO SEAT DAMAGE FROM CONTAMINATION. THE SUPPLIER AMR 5802014 WAS REVISED TO REQUIRE THE USE OF PROTECTIVE CLOSURE ON THE OUTLET PORT STARTING AT THE SUBASSEMBLY STAGE.

(E) OPERATIONAL USE

NO ACTION REQUIRED FOR THE FIRST FAILURE BECAUSE IT IS UNDETECTABLE. DURING ASCENT IF LEAK RATE DOES NOT PERMIT ET SEPARATION, A CONTINGENCY AFT ONLY SEPARATION WILL BE PERFORMED.